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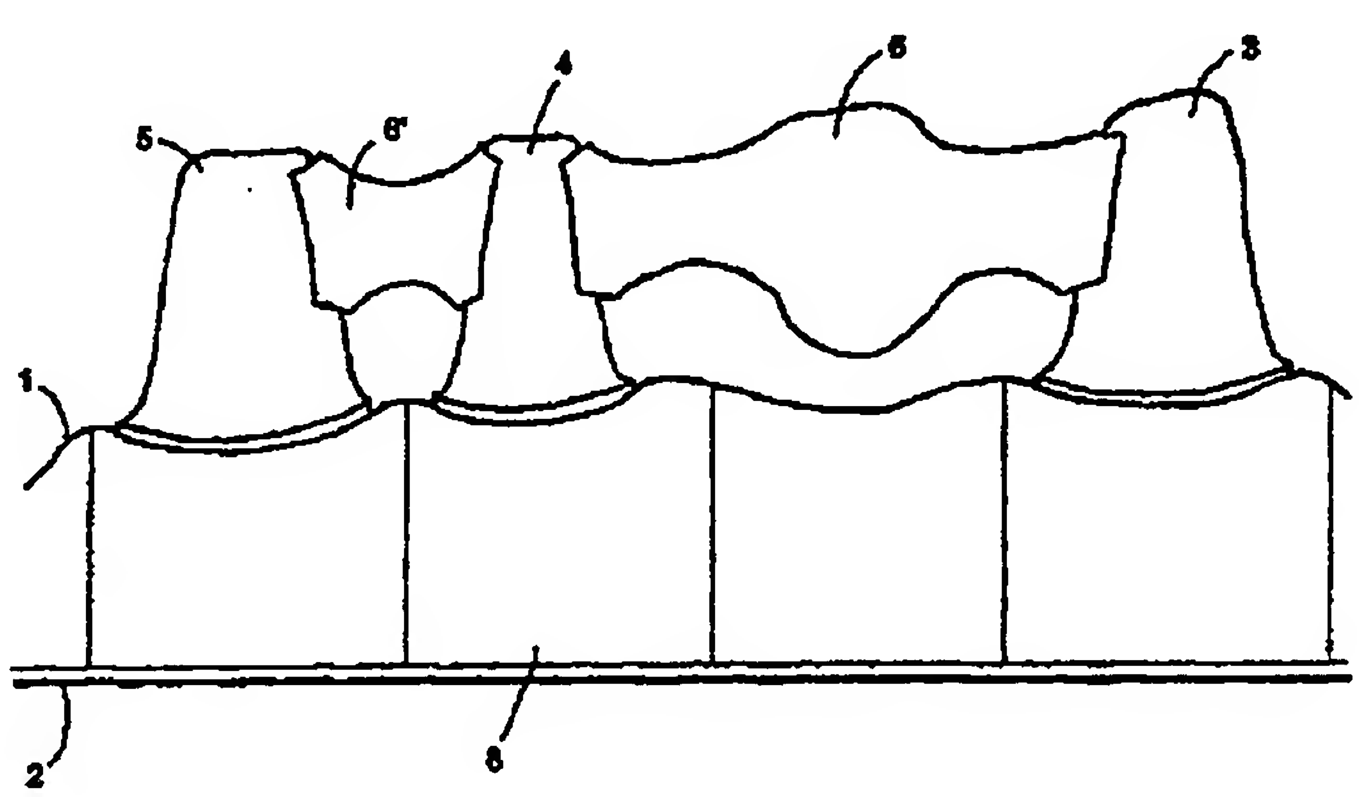
(54) Title: METHOD FOR THE FABRICATION OF TOOTH RESTAURATIONS IN THE FORM OF ALL CERAMIC BRIDGES AND MATERIAL FOR CARRYING OUT THE METHOD



(57) Abstract

On a work model (1), which consists of a holder (2), in which master dies (8) with impressions of ground teeth (3, 4, 5) or implants (7) are placed, between/on which a ceramic bridge is to be modelled, and where the teeth (3, 4, 5) – implants (7), are mounted in a correct reciprocal distance, a plate piece (6 and/or 6'), which has been cut from an alumina oxide block is adapted to the spaces in between the teeth. A coat of spacer material (9), wax, is applied to the teeth, thereafter a coat of separating material (10) and thereafter a layer of pliable substructure material (11) from alumina oxide, whereafter the plate piece (6) is positioned between two teeth and vibrated into final position, whereafter the transition areas between the plate piece and the adjacent teeth is covered and smoothed with substructure material (11), and the work model is pre-dried at approximately 50 °C for approximately 15 minutes. Thereafter the work model is exposed to radiated heat, whereby the spacer material (9) is melted and the bridge element can be removed from the work model. Thereafter the bridge element (12) is dry sintered, and after finished cooling a layer of glass is applied to the surface, and thereafter an infiltration sintering takes place. The method is fast and therefore inexpensive to use. Furthermore bridges on bridge pillars of metal, so-called implants, can be modelled up.

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Method for the fabrication of tooth restaurations in the form of all ceramic bridges and material for carrying out the method.

The present invention relates to a method for the fabrication of tooth restorations in the form of all ceramic bridges, which are shaped as a beam, which at each end are supportet by a bridge pillar in the form of a countoured tooth or a surgically inserted metalpin, a so called implant, by the use of a master die made from plaster or metal, of each bridge pillar, which may be mounted in a correct reciprocal position, which bridge consists of a substructure of aluminaoxide and an infiltration material of glass or more layers of glass ceramic,

By a known technique for the fabrication of ceramic bridges a plaster model is first made from an impression. The model receives a coat of spacer lacquer and a support is built by the use of modelling wax at the connecting linksection, which hereby will act as a support during the later application of the oxide ceramic. Hereafter a duplicating mould of silicone material is made, which, after the tensions in the silicone mould have been equalized, is cast in special plaster. The new special plaster model is removed from the mould and is glued at the bottom to a fine sintered aluminaoxide plate, and the individual sections of the model, dies and the interconnecting linksection, are separated by sawing the plaster model. Thereafter a substructure material is made, which contains oxide ceramic, which is applied to the plaster model with a brush, the model is heated to 1120 °C for 8 1/2 hours. After cooling the substructure is removed from the special plaster, and the fit of the substructure is checked on the first plaster model. Hereafter glass material is applied to the substructure, which then is sintered in a special furnace at 1100 °C for 6 ½ hours. After cooling the surplus glass is removed, and an extra coat of glass ceramic is applied. This known method is very elaborate, technique sensitive and time consuming and hence espensive to use. Since casting on metal cannot be done, this method can not be used for tooth restorations directiy based on implants.

It is the object of the present invention to describe a method for the fabrication of all ceramic bridges, whereby the mentioned disadvantages are eliminated. This is

achieved by the method as described in the characterising part of claim 1.

Claim 2 deals with a preferred temperature and time for the dry-sintering.

Claim 3 deals with a preferred temperature and time for the infiltration sintering.

Claim 4 relates to a preferred composition of a separation material according to the invention.

Claim 5 relates to a preferred mixing ratio of the components in a separation material according to the invention.

Claim 6 relates to a preferred composition of a substructure material according to the invention.

Claim 7 relates to a preferred method of production and the mix proportion of the components in a substructure material according to the invention.

Claim 8 relates to a first form for oxide ceramic to be used in a substructure material according to the invention.

Claim 9 relates to another form of oxide ceramic to be used in a substructure material according to the invention.

Claim 10 relates to a third form of oxide ceramic to be used in a substructure material according to the invention.

Claim 11 relates to a fourth form of oxide ceramic to be used in a substructure material according to the invention.

The invention shall be explained further in the following with reference to the drawing, in which

fig. 1 shows an exploded work model for the use in the method as per the

invention, with a number of master dies of plaster with impressions of ground teeth,

fig. 2 shows a picture similar to that in fig. 1, with plate-like pieces cut from an aluminaoxide block, positioned in the space between the impressions of the three ground teeth,

fig. 3 shows a master die of plaster with the impression of a ground tooth, on which a coat of spacer material and separation material have been applied,

fig. 4 shows a picture similar to that in fig. 3, in which a coat of substructure material has been added,

fig. 5 shows a picture similar to that in fig. 2, in which a coat of spacer material, separation material and a coat of substructure material have been applied to each of the ground teeth, and where plate-like pieces of aluminoxide subsequently are positioned in the spaces between the teeth, and the transitions between the teeth and the plate-like pieces are covered by substructure material,

fig. 6 shows a finished bridge element, which has been removed from the work model - fig. 5 - after sintering,

fig. 7 shows a picture similar to that in fig. 1 with master dies of plaster with impressions of metal pins/implants,

fig. 8 shows a picture similar to that in fig. 7 with a plate-like piece from the work aluminaoxide block, positioned in the space between the implant-impressions,

fig. 9 shows a picture similar to that in fig. 8, in which a coat of spacer material, separation material and a coat of substructure material have been applied to the implant impressions, and where plate-like pieces of aluminoxide

subsequently have been positioned in the space between the implant impressions and the transitions have been covered by substructure material, and

fig. 10 shows a finished bridge element after finished sintering.

As shown in fig. 1 a number of master dies 8 are mounted in a correct reciprocal position in a holder 2, with which they constitute a work model 1. On three of the master dies 8 there are impression of ground teeth 3, 4 and 5. The impressions of the ground teeth or implants constitute bridge pillars for the bridge construction to be modelled as per the invention. In the present case a bridge is to be modelled between teeth 3 and 5 with tooth 4 as an interval support.

The bridge pillars can, as shown in fig. 7, also be metal pins, which have been inserted in a jaw bone, so-called implants 7.

As shown in fig. 2 and 8 first, according to the method of the invention, a plate 6 and/or 6' is adapted, which has been cut from an aluminaoxide block in such a way that the plate 6 or 6' fit precisely in the space between the bridge pillars 3,4 and 4,5 respectively or 7,7 on the work models 1 and 1', fig. 1 and fig. 7. Hereafter the aluminaoxide plate 6 is further reduced to a plate which has the interlink shape characteristic for all ceramic bridge constructions. The plate 6 is soaked with demineralized water and kept moist, i.e. by staying in contact with water droplets, for later use.

The work model 1 and 1' consist of a number of master dies 8, which are mounted in a holder 2. As shown in fig. 3 the master dies are applied a coat of spacer material 9, which can consist of modeling/spacer wax and subsequently a coat of separation material 10, which advantageously can consist of completely combustable modelling wax and chloroform in such a mixture that the material is liquid and brushable at 22 °C, but will harden at 20 °C . These characteristics are obtained at a mixture of 6 g modelling wax to 30 ml chloroform.

Hereafter alumina powder is mixed with a special liquid by the aid of ultrasound into a paste or substructure material 11, which is applied to the master dies 8, as shown in fig. 4, by using a suitable modelling instrument.

According to the invention the substructure material 11 can consist of demineralised water, cellulose powder, sugar and an oxide ceramic, and it can be produced by first making a liquid, with a mixing ratio of 75 ml demineralised water to which is added 0,5 g cellulose derivative and stirring it for approx. one minute, whereafter the mixture is passed through a chemical paper filter and adding 1.5 g sugar, whereafter 1,36 ml of this liquid is mixed with 10 g of oxide ceramic.

As an oxide ceramic can be used either aluminum oxide, zirconium oxide, magnesium oxide, a mixture af aluminum oxide and zirconium oxide, a mixture of magnesium oxide and zirconium oxide, or a mixture of aluminium oxide and magnesium oxide.

The separation material 10 prevents the substructure material 11 from drying out during the process of application onto the master die. At the same time the separation material 11 diffunds into both the plaster in the master die and into the substructure material 11 during the dryingprocess, so that the substructure material after the drying process is easy to remove from the master die as an independent substructure unit without damage to the master die.

The master dies 8, with the applied substructure material 11 - alumina oxide - are put back in the work model 1 and kept moist, i.e. by staying in contact with water droplets.

The plate pieces 6 are thereafter carefully positioned between the bridge pillars 3, 4, 5 or 7, and by adding small vibrations the plate pieces 6 are guided to their final position. The transition areas between the plate pieces 6 and the bridge pillars 3, 4, 5 or 7 are covered and smoothed out, as shown in fig. 5 and 9, with substructure material 11.

The work model is hereafter pre-dried in a drying oven at approx. 50 °C for approx. 15 minutes. After pre-drying the work model is placed underneath the muffle of a porcelain furnace, and is heated by the furnace's heat radiation, so that the spacer material 9 melts. The separating material will at the same time dissipate into both the plaster of the master die and the substructure material 11. Hereafter the bridge element 12 can be removed without damage to the master die, by turning the model and carefully tap the upper part of the holder 2.

The finished modelled bridge element 12 is sintered in a porcelain furnace at 1120 °C for approx. 2 hours. During the firing the wax, the binding material and the aluminaoxide material are sintered trough a so-called dry-sintering. Hereafter the sintered bridge element 12 is checked on the work model 1, and the fit is adjusted further by means of suitable grinding tools.

Thereafter infiltration glass is applied to the surface of the bridge element 12, and the bridge element is fired by a so-called infiltration sintering, which preferably takes place at 1140 °C for approx. 40 minutes. After final firing possible excess glass is removed from the finished bridge element.

The spacer material 9, the separating material 10 and the substructure material 11 also may be used for fabrication of tooth restaurations in the form of individual crowns.

PATENT CLAIMS.

1. Method for the fabrication of tooth restaurations in the form of all ceramic bridges, which are shaped as a beam, which at each end are supported by a bridge pillar in the form of a contoured tooth or a surgically inserted metal pin, a so-called implant, by the use of a master die made from plaster or metal, each bridge pillar, which may be mounted in a correct recipropal position, which bridge consists of a substructure of aluminaoxide and an infiltation material of glass or more layers of glass ceramic,

characterized by the fact that that first a plate is cut to a necessary thickness from an aluminaoxide block, of which plate a plate piece (6) and/or (6') is cut, which fits precisely between the bridge pillars (3,4) and (4,5) respectively - fig. 2 - or (7,7) - fig. 8 - on the work model (1), which plate piece thereafter is prepared and reduced further to achieve the interlink shape characteristic for all ceramic bridge constructions, and thereafter is kept moist with demineralized water for later use, that the master dies (8) are removed from the work model (1),and by which the surface of each bridge pillar is first coated by a spacer material (9), preferably wax, and thereafter a layer of separating material (10), which seals the surface of the master die, whereafter a substructure material (11) is applied, which contains oxide ceramic, demineralized water, a coagulating material and a binding material in such a combination that the mixture after stirring, preferebly in an ultrasonic mixer, is pliable, whereafter the master dies are put back in the work model and kept moist, whereafter the plate piece (6) is positioned between the two bridge pillars with modelled substructure plast material and brought to its final position while applying small vibrations, whereafter the transition areas between the plate piece and the bridge pillars are covered and smoothed with substructure material using a brush, and possible excess material is removed, whereafter the work model is pre-dried in a drying oven at aprox. 50 °C for approx. 15 minutes, and the pre-dried work model is exposed to radiated heat, whereby the spacer material is melted, whereafter the work model is turned upside down and the bridge element (12) is released from the work model (1) by carefully tapping, whereafter the bridge element (12) is fired at a so-called dry sintering and is thereafter cooled, whereafter another structure is applied, which consists of a layer of glass, and thereafter is fired again at

a so-called infiltration sintering, whereby an infiltration of the glass into the bridgestructure material is taking place.

2. Method according to claim 1, characterized by the fact that the dry sintering consists in the bridge element beeing sintered in a porcelain furnace at a temperature of approx. 1120 °C for 2 ½ hours.

3. Method according to claim 1, characterized by the fact that the infiltration sintering consists in the bridge element beeing sintered in a porcelain furnace at a temperature of approx. 1140 °C for 40 minutes.

4. The separation material to be used in the procedure according to claim 1, characterized by the fact that the separation material 10 consists of fully combustible plasticine and chloroform with a mixing ratio so that the material is applicable with a brush at about 22 °C but hardens at about 20 °C.

5. Separation material according to claim 4, characterized by the fact that the separation material 10 contains plasticine and chloroform in a mixing ratio of 6 g of plasticine to 30 ml of chloroform.

6. Substructure material for application in the procedure according to claim 1, characterized by the fact that the substructure material (11) consists of demineralised water, cellulose powder, sugar and oxide ceramic, which after stirring is stored in airtight containment.

7. Substructure material according to claim 6, characterized by the fact that the substructure material (11) is produced by first making up a liquid, with a mixing ratio of 75 ml of demineralised water to which is added 0,5 g cellulose derivative and stirred for approx. one minute, whereafter the mixture is passed through a chemical paper filter and added 5 g of sugar, and that 1,36 ml of this liquid is mixed with 10 g of oxide ceramic.

8. Substructure material according to claim 6, characterized by the fact that aluminum oxide is used as oxide ceramic.

9. Substructure material according to claim 6, characterized by the fact that zirconium oxide is used as oxide ceramic.

10. Substructure material according to claim 7, characterized by the fact that magnesium oxide is used as oxide ceramic.

11. Substructure material according to claims 9-11, characterized by the fact that a mixture af aluminum oxide and zirconium oxide, of magnesium oxide and zirconium oxide, or of aluminium oxide and magnesium oxide is used as oxide ceramic.

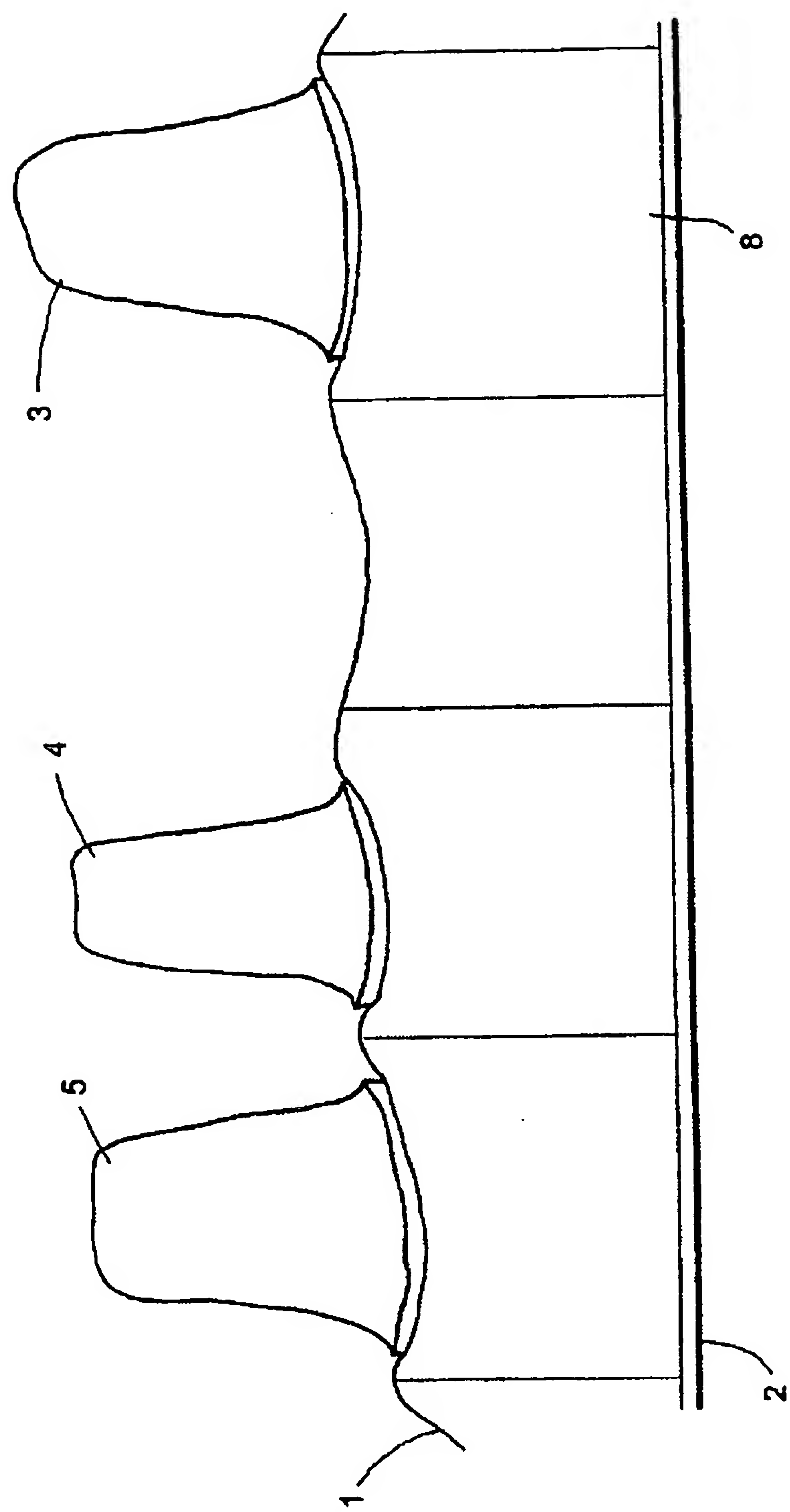

Fig. 1

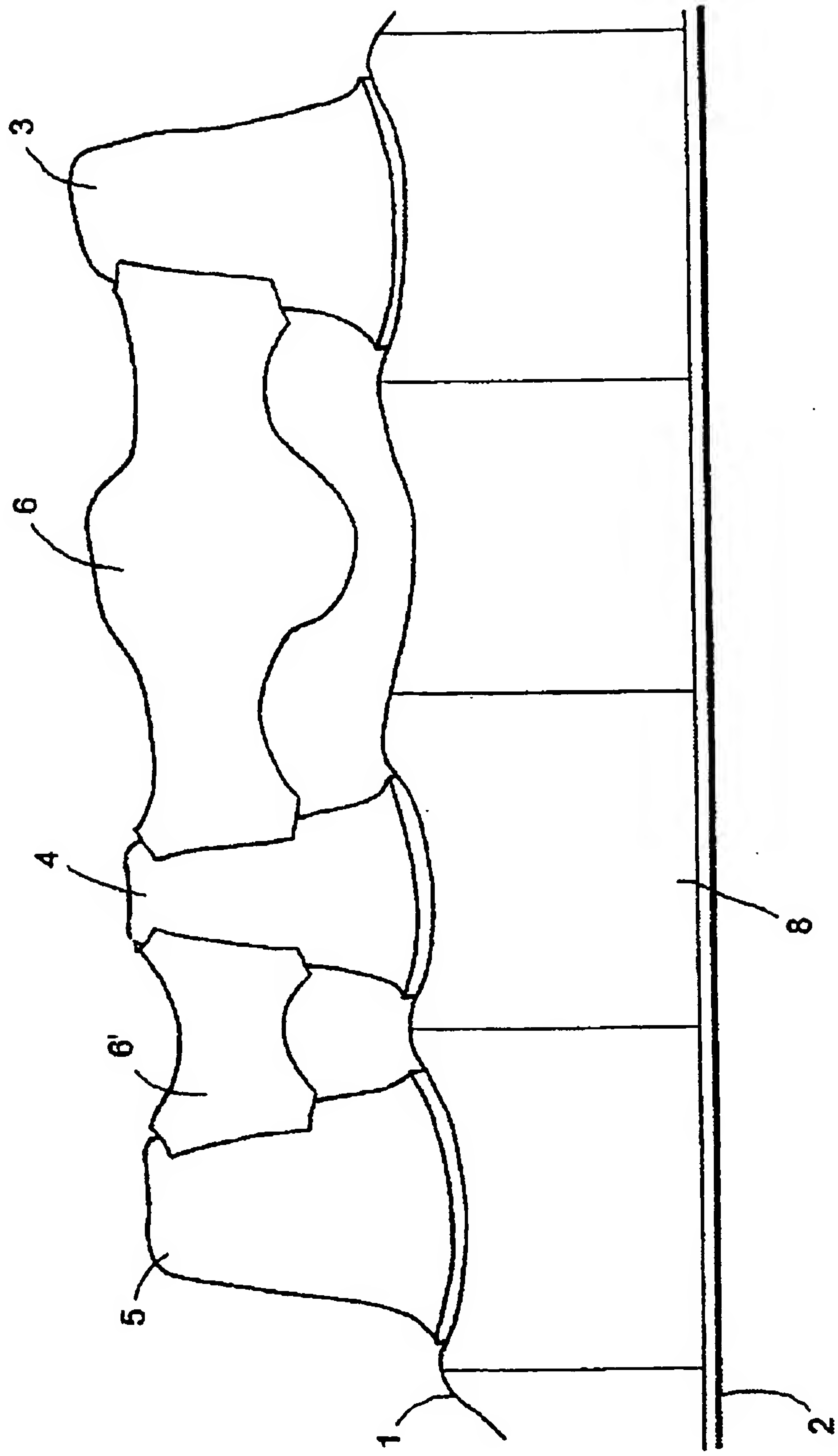

Fig. 2

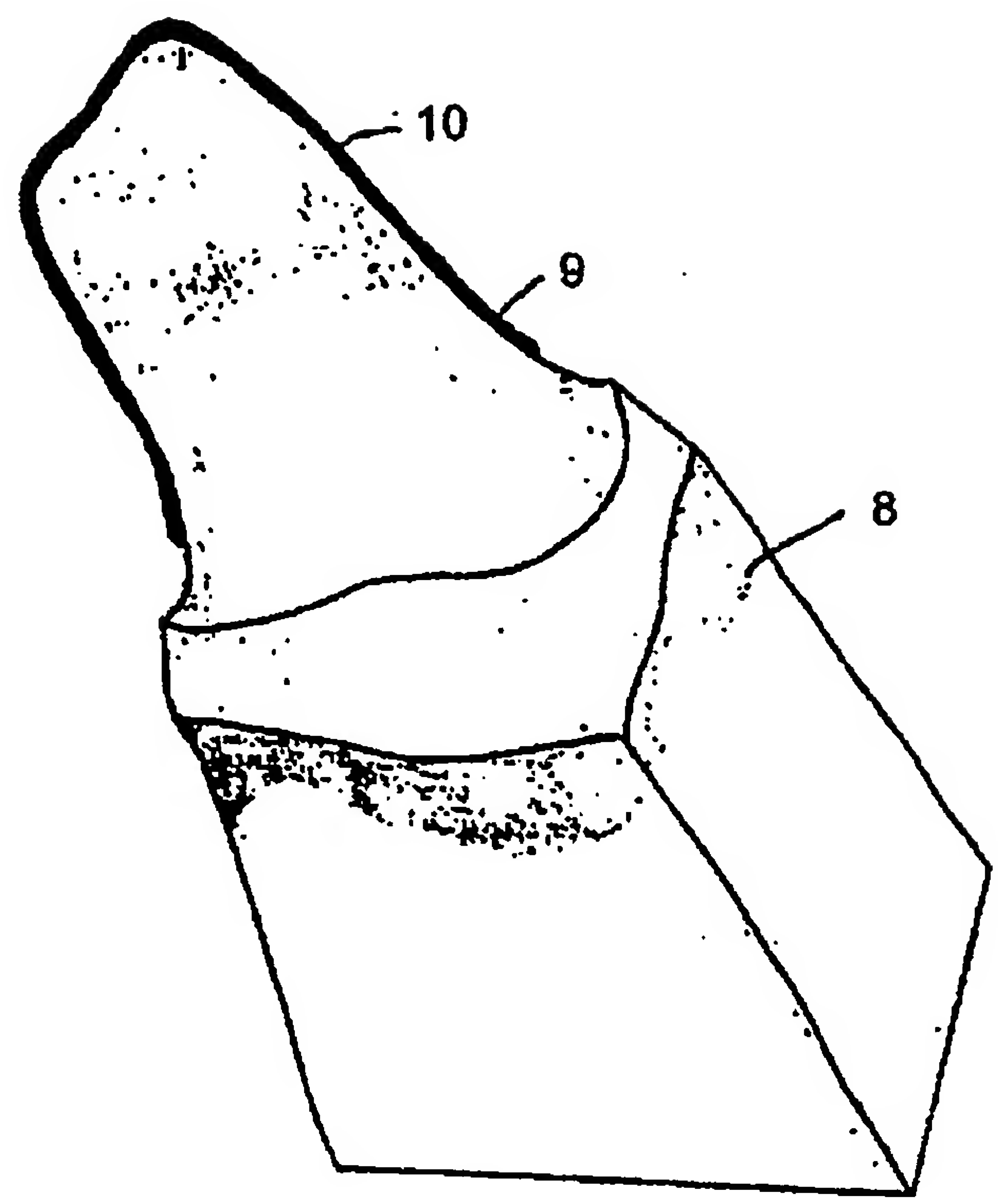

Fig. 3

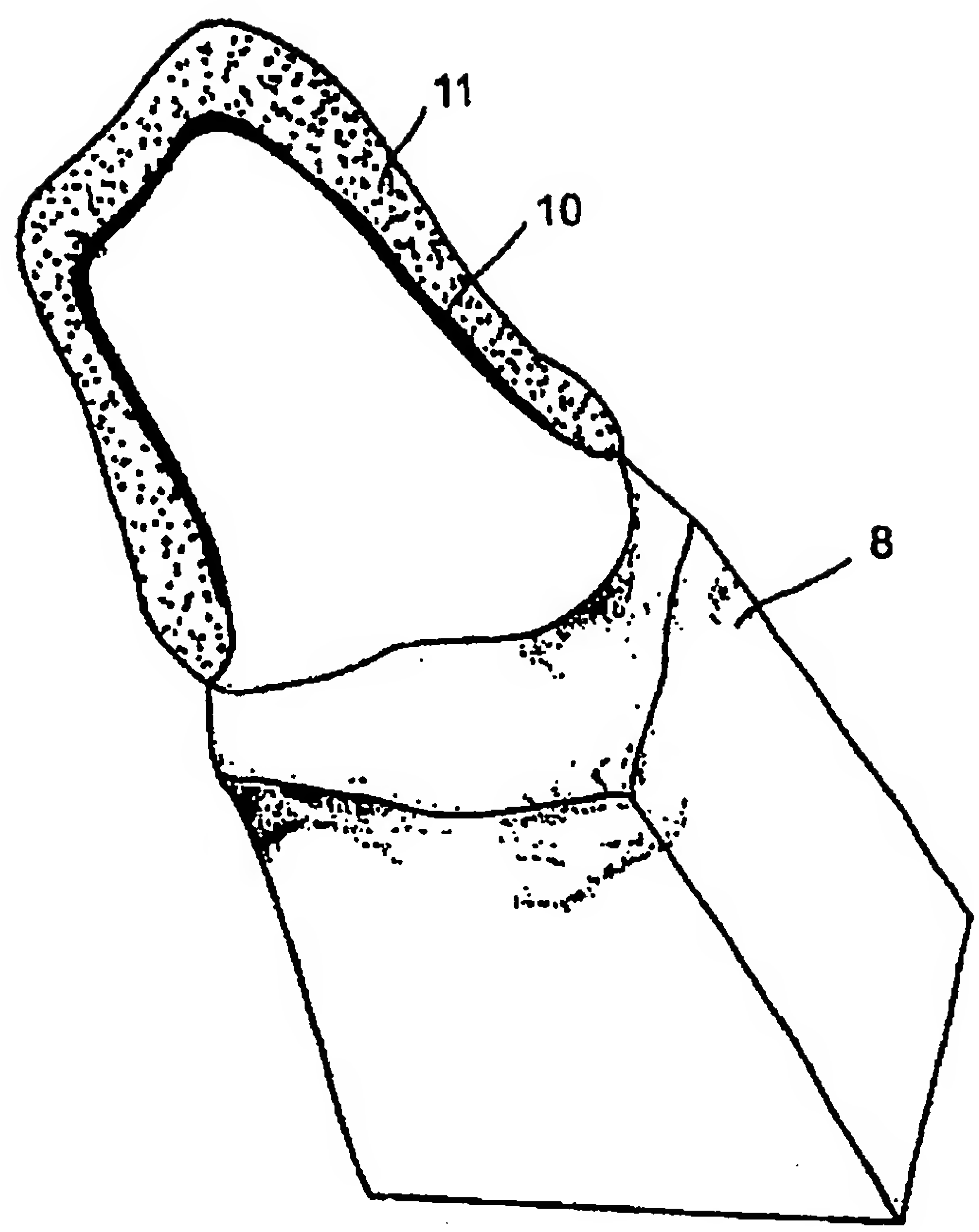

Fig. 4

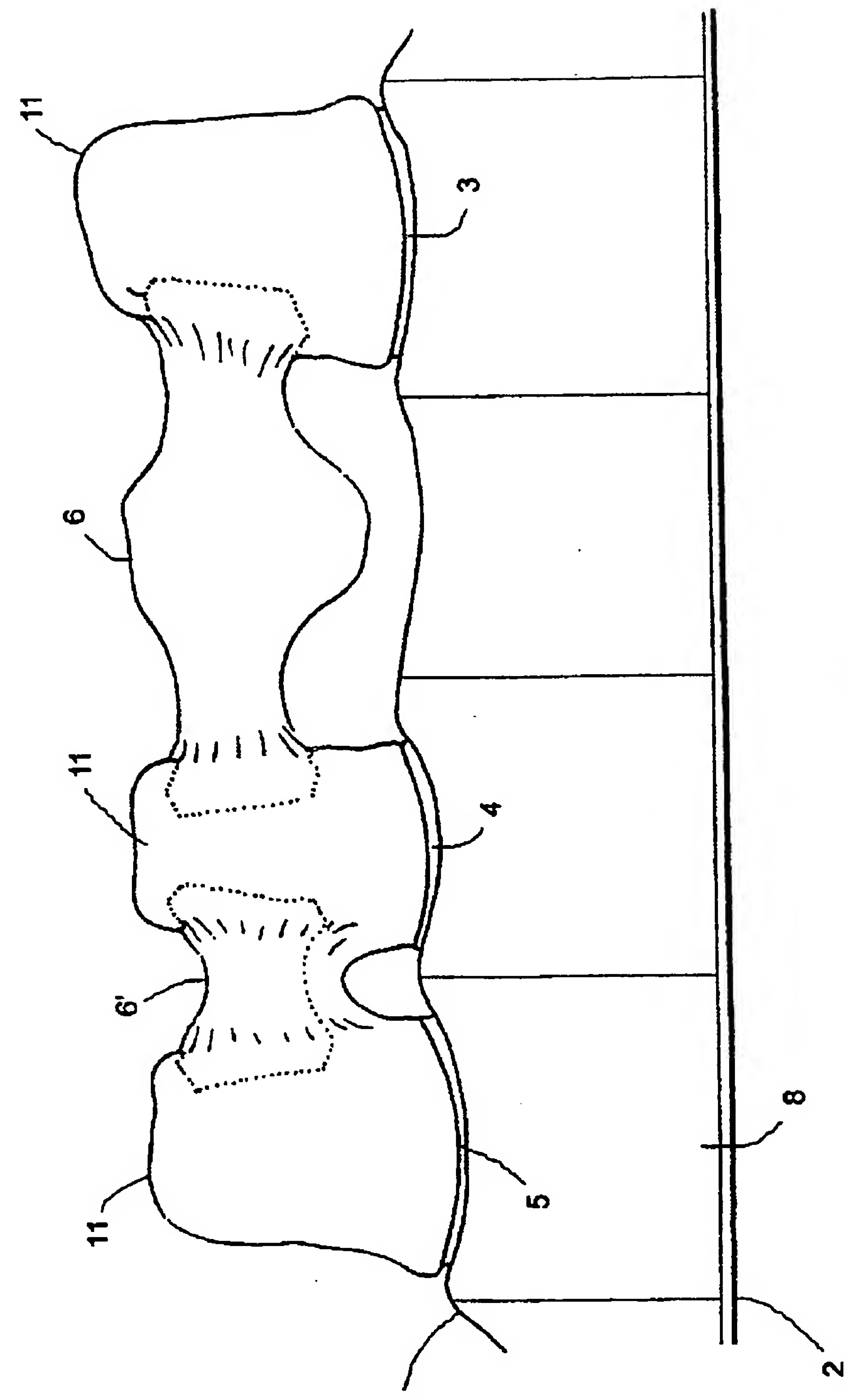

Fig. 5

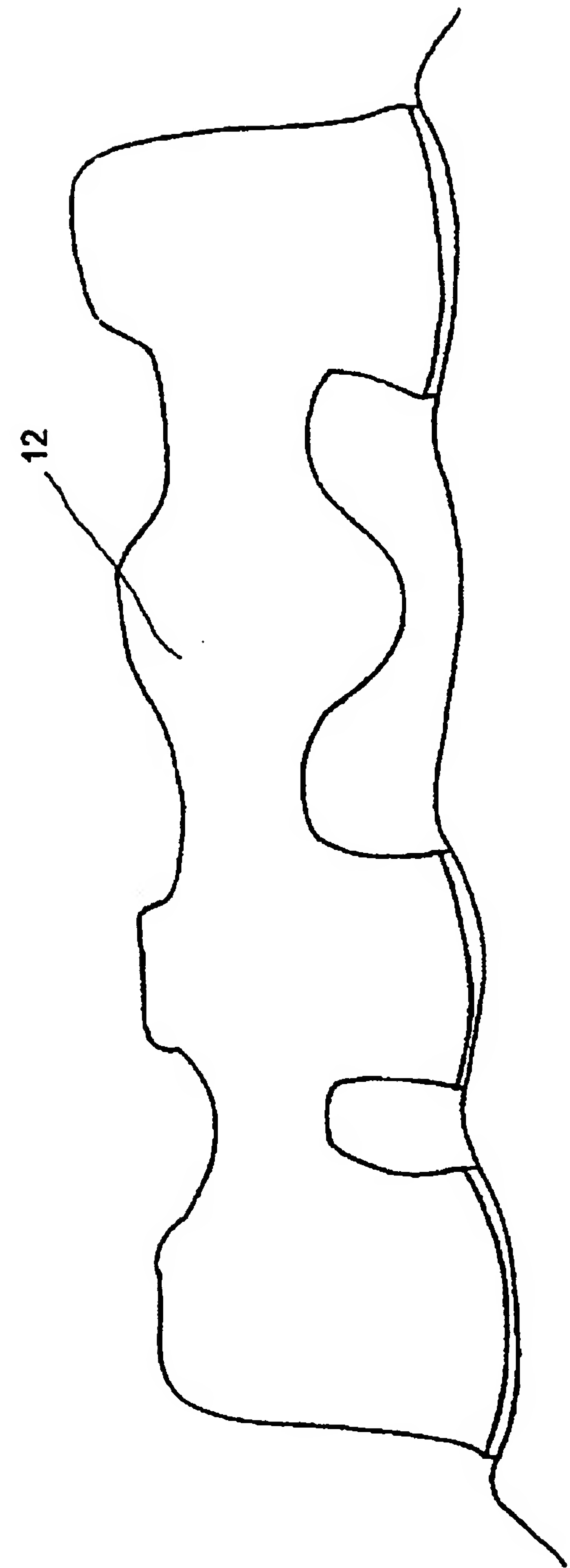

Fig. 6

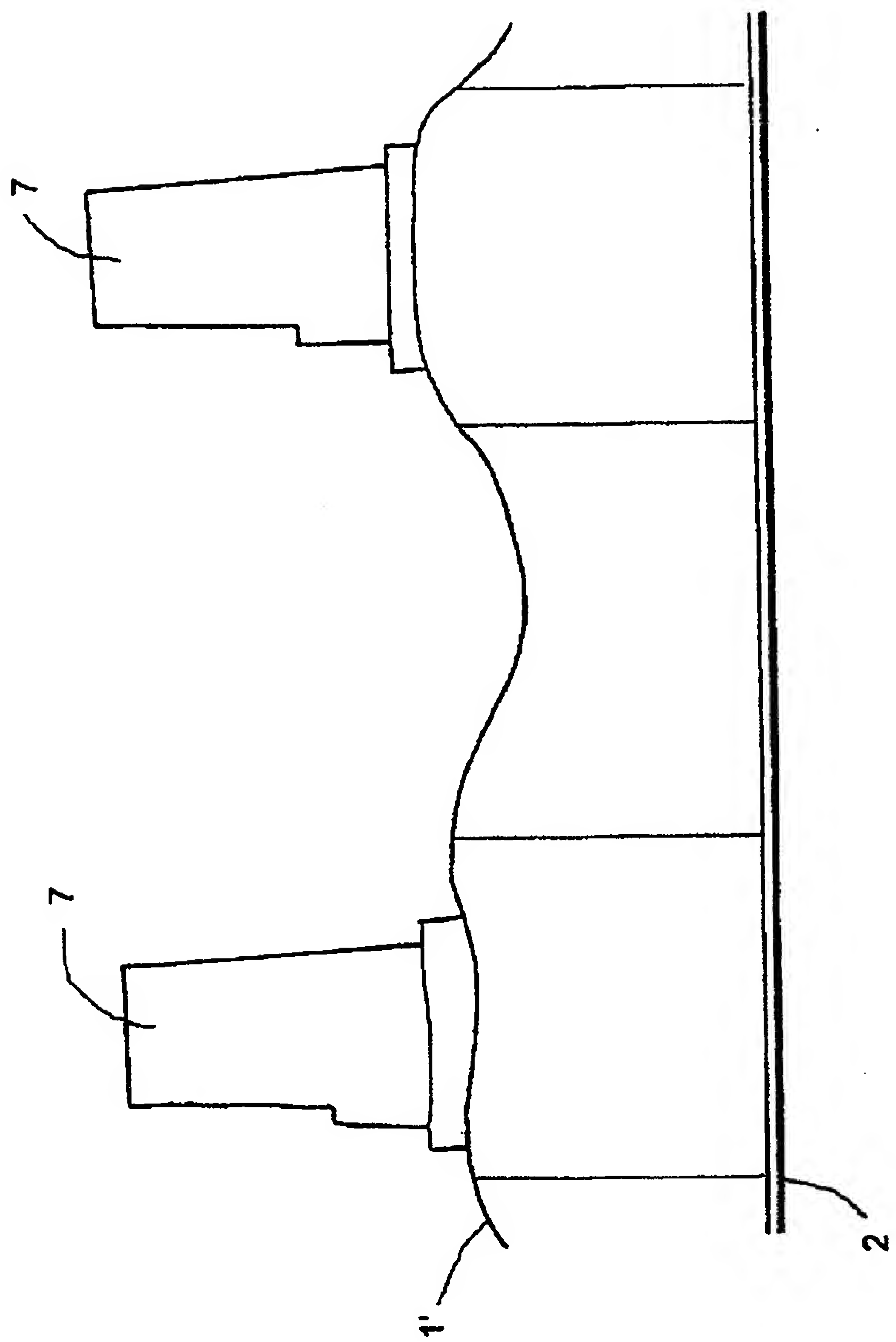

Fig. 7

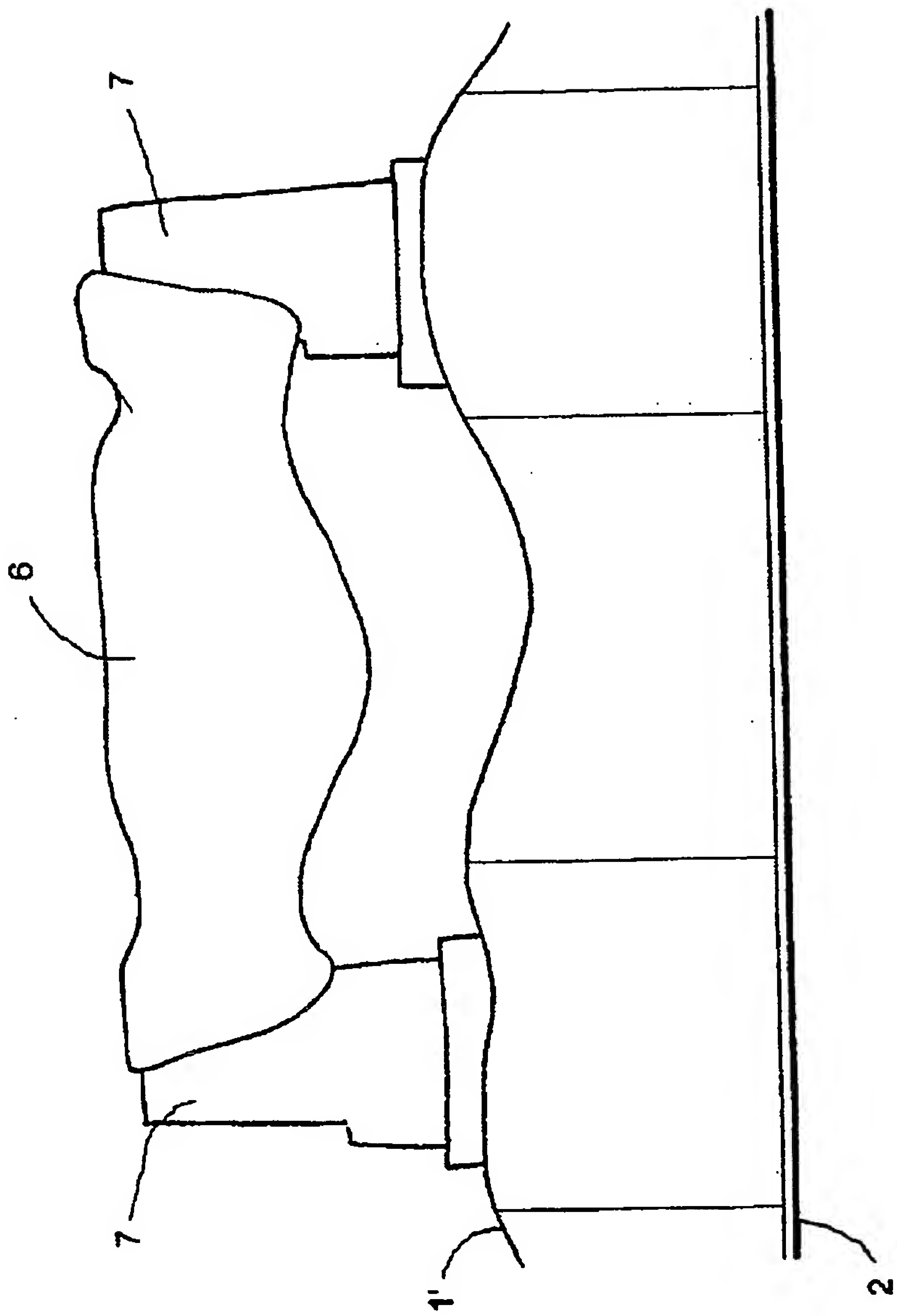

Fig. 8

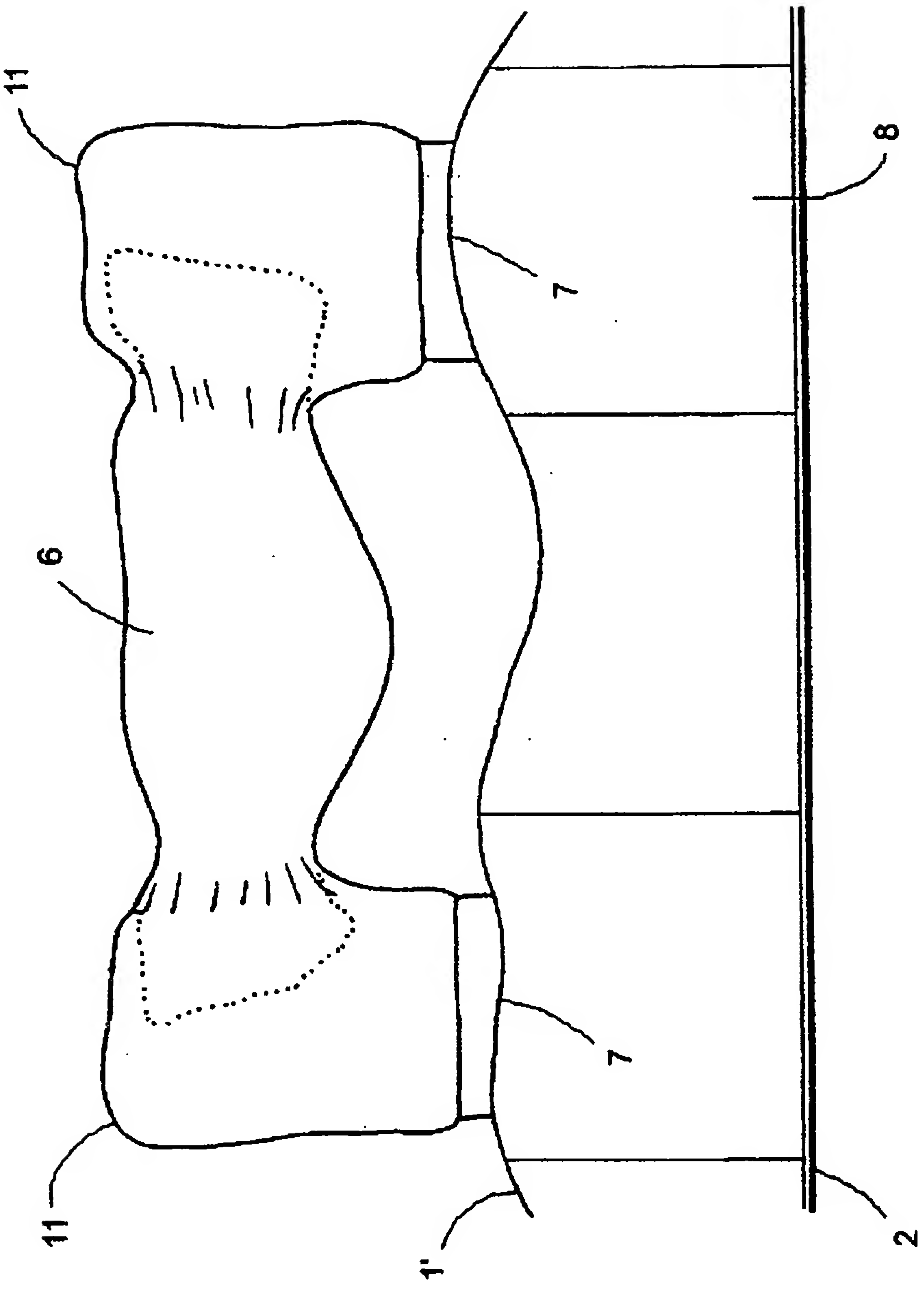

Fig. 9

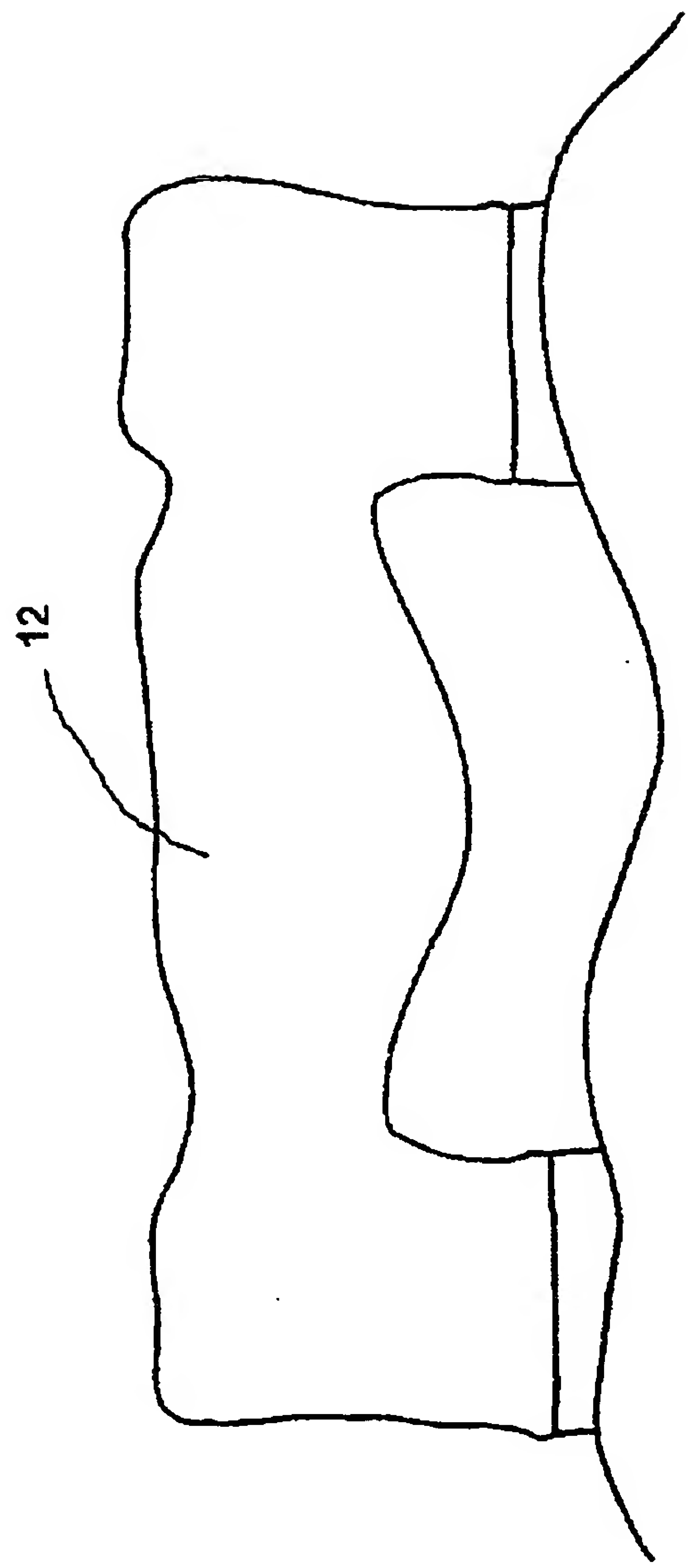

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 98/00129

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61C 13/00, A61C 8/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9535070 A1 (DIRK, LEONHARDT), 28 December 1995 (28.12.95), see claims 5-12	4-11
A		1-3
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Date of the actual completion of the international search	Date of mailing of the international search report
23 November 1998	24 -11- 1998

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Information on patent family members

03/11/98

International application No.

PCT/DK 98/00129

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9535070 A1	28/12/95	AU 2446195 A	15/01/96
		DK 72194 A	21/12/95
		EP 0794740 A	17/09/97

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